



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference BPCL 9944	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB 03/04052	International filing date (day/month/year) 23.09.2003	Priority date (day/month/year) 08.10.2002
International Patent Classification (IPC) or both national classification and IPC C10G70/02		
Applicant BP CHEMICALS LIMITED et al		
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 3 sheets.</p>		
<p>3. This report contains indications relating to the following items:</p> <p>I <input checked="" type="checkbox"/> Basis of the opinion</p> <p>II <input type="checkbox"/> Priority</p> <p>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p>IV <input type="checkbox"/> Lack of unity of invention</p> <p>V <input checked="" type="checkbox"/> Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p>VI <input type="checkbox"/> Certain documents cited</p> <p>VII <input type="checkbox"/> Certain defects in the international application</p> <p>VIII <input type="checkbox"/> Certain observations on the international application</p>		
Date of submission of the demand 21.04.2004	Date of completion of this report 10.01.2005	
Name and mailing address of the international preliminary examining authority:  European Patent Office - Gitschiner Str. 103 D-10958 Berlin Tel. +49 30 25901 - 0 Fax: +49 30 25901 - 840	Authorized Officer Clement, J-P Telephone No. +49 30 25901-325 	

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International application No. PCT/GB 03/04052

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1-23 as originally filed

Claims, Numbers

1-16 received on 22.12.2004 with letter of 21.12.2004

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

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**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes: Claims	1-16
	No: Claims	
Inventive step (IS)	Yes: Claims	1-16
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-16
	No: Claims	

2. Citations and explanations

see separate sheet

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Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following document/s/:

D1: US-A- 4 299 800

D2: GB-A-565 991

The document D2 is regarded as being the closest prior art to the subject-matter of claims 1 and discloses (page 1 , lines 58-98) a process for removing oxygen from oxygen containing gaseous olefines, which process comprises contacting the gas mixture with a catalyst. Metals or oxides of nickel, platinum and palladium are disclosed as preferred catalysts.

The subject-matter of claim 1 differs from this known D2 in that the catalyst also comprises tin.

The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

The presence of tin in the catalyst improves the removal of oxygen. Thus the subject-matter of claim 1 is also considered as involving an inventive step (Article 33(3) PCT).

The document D1 is regarded as being the closest prior art to the subject-matter of claims 2 and discloses (col 1, line 54- col 2, line 60):
a method for the removal of oxygen from a gas mixture comprising oxygen, olefin, hydrogen and carbon monoxide which process comprises contacting the gas mixture with a silver and/ or gold catalyst (metals of the 11 th group of the Periodic Table of Elements). Zeolite is explicitly disclosed as a possible catalyst support.

The subject-matter of claim 2 differs from this known D1 in that, in addition to oxygen, alkyne is also removed from the gas mixture.

The subject-matter of claim 2 is therefore new (Article 33(2) PCT).

When the gas mixture comprises alkyne in addition to olefin and oxygen the performance of copper (or silver or gold) in the process of removing oxygen and alkyne from a gas mixture can be improved by being supported on a zeolite. Thus the subject-matter of claim 2 is also considered as involving an inventive step (Article 33(3) PCT).

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Claims 3-16 are dependent on claim 1 or 2 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

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Claims

1. A process for the removal of oxygen from a gas mixture comprising oxygen, at least one olefin, hydrogen, carbon monoxide and optionally at least one alkyne, the ratio of oxygen : hydrogen in the gas mixture being 1 part by volume of oxygen to at least 5 parts by volume of hydrogen, which process comprises contacting the gas mixture with a catalyst in a reaction zone under conditions sufficient to oxidise at least a portion of the hydrogen and to oxidise at least a portion of the carbon monoxide and without significant hydrogenation of the at least one olefin, wherein the catalyst comprises at least one metal or oxide of a metal from the 10th group of the Periodic Table of Elements, the metal or oxide of the metal being supported on an oxide support, provided that the catalyst also comprises tin.
2. A process for the removal of oxygen and alkyne from a gas mixture comprising oxygen, at least one olefin, hydrogen, carbon monoxide and at least one alkyne, the ratio of oxygen : hydrogen in the gas mixture being at least 1 part by volume of oxygen to at least 5 parts by volume of hydrogen, which process comprises contacting the gas mixture with a catalyst in a reaction zone under conditions sufficient to oxidise at least a portion of the hydrogen and to oxidise at least a portion of the carbon monoxide and without significant hydrogenation of the at least one olefin, wherein the catalyst comprises at least one metal or oxide of a metal selected from the group consisting of the 10th group and the 11th group of the Periodic Table of Elements, the metal or oxide of the metal being supported on an oxide support, provided that where the catalyst comprises at least one metal or oxide of a metal from the 10th group of the Periodic Table of Elements supported on an oxide support, the catalyst also comprises tin and

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- provided that where the catalyst comprises at least one metal or oxide of a metal of the 11th group of the Periodic Table of Elements the oxide support is a zeolite.
3. A process according to claim 1 or claim 2 wherein the gas mixture contains 2000 ppm or less of oxygen.
 4. A process according to any one of claims 1 to 3 wherein the gas mixture comprises at least 10 vol% of hydrogen.
 5. A process according to claim 4 in which the gas mixture comprises at least 20 vol % hydrogen.
 6. A process according to any one of the preceding claims in which the gas mixture comprises from greater than 0 up to and including 20 vol % alkyne.
 7. A process according to claim 6 in which the alkyne is acetylene.
 8. A process according to anyone of claims 2 to 7 wherein the catalyst comprises at least 0.01wt%, based on the total weight of the dry catalyst, of at least one metal or oxide of a metal selected from copper, silver and gold, supported on a zeolite support.
 9. A process according to claim 8 in which the catalyst comprises copper in an amount in the range of from 1 to 15 wt %.
 10. A process according to claim 8 or claim 9 wherein the zeolite is zeolite A or zeolite X.
 11. A process according to any one of claims 1 to 7 in which the catalyst comprises at least 0.01wt%, based on the total weight of the dry catalyst, of at least one metal or oxide of a metal selected from nickel, palladium and platinum supported on silica or alumina.
 12. A process according to claim 11 wherein the metal is platinum and is present in an amount in the range 0.01 – 15 wt% based on the total weight of the dry catalyst and is supported on silica.
 13. A process according to claim 11 or claim 12 wherein tin is present in the catalyst in an amount in the range 0.01 to 60 wt% based on the total dry weight of the catalyst.
 14. A process according to any one of the preceding claims wherein the gas mixture is contacted with the catalyst in the reaction zone at a temperature in the range 50-300° C.
 15. A process according to anyone of the preceding claims wherein the gas mixture is contacted with the catalyst in the reaction zone at a total pressure in the range 15-35 bara.

16. A process according to any one of the preceding claims wherein the process comprises the steps :

(a) contacting at least one hydrocarbon with a molecular oxygen-containing gas in a first reaction zone with a catalyst capable of supporting combustion beyond the normal fuel-rich limit of flammability and wherein the stoichiometric ratio of hydrocarbon to oxygen is 5 to 16 times the stoichiometric ratio of hydrocarbon to molecular oxygen-containing gas for complete combustion to carbon dioxide and water, to produce a product stream comprising oxygen, at least one olefin, hydrogen, carbon monoxide and optionally at least one alkyne,

(b) contacting in a second reaction zone, at least a portion of the product stream from step (a) having a ratio of oxygen to hydrogen of at least one part by volume of oxygen to at least 5 parts by volume of hydrogen with a catalyst under conditions sufficient to oxidise at least a portion of the hydrogen and to oxidise at least a portion of the carbon monoxide and without significant hydrogenation of the at least one olefin, wherein the catalyst comprises at least one metal or oxide of a metal selected from the group consisting of the 10th group and the 11th group of the Periodic Table of Elements, the metal oxide of the metal being supported on an oxide support, provided that where the catalyst comprises at least one metal or oxide of a metal from the 10th group of the Periodic Table of Elements supported on an oxide support, the catalyst also comprises tin and provided that where the catalyst comprises at least one metal or oxide of a metal of the 11th group of the Periodic Table of Elements the oxide support is a zeolite.